

Manufacture of a paste of nano-silver and nano-zinc for the restoration of manuscripts and the inhibition of fungi

Abstract

This study was conducted in the Collage of Education for Pure Sciences at the University of Karbala as a part of series of isolation and diagnosis of fungi associated with historical manuscripts in the Center for the maintenance and restoration of manuscripts and the care of researchers for the period from /2018 to 2019, at the holy shrine of Hussein in the city of Karbala. In order to preserve the manuscripts and the use of zinc nanoparticles and silver nanoparticles to control the fungi that cause damage to the manuscripts and described as an additive to the restoration paste.

The fungi were diagnosed molecularly by PCR method and were represented by seven fungi registered for the first time in Iraq in general and on the manuscripts in particular. They are *Alternaria atra* , *Aspergillus ustus*, *Cladosporium exasperatum*, *Chaetomium globosum*, *Microdochium nivale* , *1-Penicillium tardochrysogenum* , *2- Penicillium tardochrysogenum* . It was registered at the Genbank World Bank. The Blast program was used to identify the genetic tree of the detected fungi as well as to determine the relationship of homology to international isolates.

All seven fungi recorded in the World GeneBank recorded an effect with silver nanoparticles and zinc nanoparticles . *Alternaria atra* and *Penicillium tardochrysogenum*1 had the highest inhibition rate of 10 mm fungal colony diameter, when treated with 25 mg L⁻¹ zincnanoparticle maixed with PDA, which did not significantly differ from *Microdochium nivale* and *1-Penicillium tardochrysogenum*. *Alternaria atra* and *2-Penicillium tardochrysogenum* , showed the highest inhibition rate of fungal colony diameter of 13.33 mm when treated with 25 mg L⁻¹ nanoparticles of PDA.

Microscopic examination of fungal hypha showed that they had an effect on nanocomposites with increasing concentration of nanomaterial. This effect ranges from the complete destruction of the fungal hypha and its explosion, especially in high concentrations of nanomaterials, to the aggregation of fungal cell protoplasm, especially in medium concentrations of nanomaterials, or deviation in the course of the fungus hypha keep away from the toxic substance by agglomeration in a certain place of the microscopic space under examination, especially in low concentrations, as well as reduction of conidia either small size or deformation depending on the type of fungus and the concentration of nanomaterials.

Tests of samples taken from smears from old manuscripts after treatment with the high concentration of 25 mg per liter of paste prepared for the purpose of restoration of each individual zinc or silver nanoparticles were reduced by the number of fungi compared to the manuscript before restoration.



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